WESTERN MULTIPLEX CORPORATION

300 Harbor Boulevard Belmont, CA 94002
(415) 592-8832 • Fax (415) 592-4249

June 18th, 1996

Mr. William Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W.
Washington, D.C. 20554

Re ET Docket No. 96-8

Dear Mr. Caton:

Transmitted herewith are an original and nine (9) copies of the Comments of Western Multiplex Corporation in response to the above Notice of Proposed Rulemaking by the Commission released on Februrary 5th 1996

Please address any questions concerning this matter directly to the undersigned.

Very truly yours,

Graham Barnes
Director of Marketing

Before the
FEDERAL COMMUNICATIONS COMMISSION FCC 96-36
Washington, DC 20554

In the Matter of	)	
	)	
Amendment of Parts 2 and 15 of the Commission's Rules Regarding Spread Spectrum Transmitters	)	ET Docket No. 96-8 RM-8435, RM-8608, RM-8609

Adopted: January 30, 1996 Released: February 5, 1996

COMMENTS OF WESTERN MULTIPLEX

Western Multiplex Corporation (WMC), pursuant to Section 1.415 of the Commission's rules, hereby submits these comments on the above referenced Notice of Proposed Rule Making. WMC is a major supplier of Part 15 radios operating in the 2450 MHz and 5800 MHz with spread spectrum technology. WMC has many years of experience and considerable practical knowledge of the market's needs for these products. WMC has successfully designed, manufactured and marketed Part 15 spread spectrum radios and developed extensive technical experience in the operation of communications systems in the unlicensed ISM environment which requiring co-existence with a wide variety of unlicensed equipment manufactured by others as well as other emissions generated by non-communications equipment using the ISM bands. Western Multiplex is a member of the Part 15 Coalition and is in general agreement with the comments submitted by the Part 15 Coalition on this NPRM. Western Multiplex is submitting these comments in addition to the Part 15 Coalition in order to highlight the specific areas that are of concern to users of our equipment.

A. MOST OF THE COMMENTING PARTIES SUPPORT WMC'S REQUEST

Western Multiplex sincerely appreciates the FCC's efforts in addressing our original petition for rulemaking by issuing this NPRM. We would like to note that our request, and the support given to it, was for a simple authorization of the continuing use of directional antennas at 2450 MHz and 5800 MHz. Thus having said, the NPRM proposes some additional regulatory burden that is not desired by WMC and was not proposed by the most of the commenting parties who supported our original request.

B. WMC RESPONSE TO FCC PROPOSED CHANGES TO THE REGULATIONS, APPENDIX B OF THE NPRM.

Specifically, WMC agrees with the Commission on all the proposed changes to the regulations contained in Appendix B of the NPRM with the following exceptions:

(a) Section 15.204(d) should be deleted

This Section should be deleted in order to implement the use of directional antennas with gains in excess of 6 dBi as well as to enable professional installation in accordance with Section 15.203

(b) Section 15.247(b)(4) should be modified to read as follows.

"Systems operating in the 2400-2483.5 MHz and 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of 1 Watt is not exceeded."

This proposed wording accomplishes the goal of removing EIRP limits and adds the 2450 MHz band. It simplifies the specification and eliminates the confusing and complex power reduction proposal

(c) Section 15.247 (b) (4) (i) should be modified to read as follows:

"Fixed point-to-point operation excludes the use of point-to-multipoint systems, omnidirectional applications, and more than two co-located intentional radiators transmitting the same information. Fixed point-to-point operation includes temporary fixed (stationary) systems and point-to-point repeaters."

This proposed wording clarifies the definition of 'fixed' and 'point-to-point' operation.

(d) Section 15.247 (b) (4) (v) should be deleted

This requirement has been applied uniquely to systems with high gain antennas due to a misconception that RF exposure is increased when using directional antennas. If this regulation is required to systems operating with power levels of 1 Watt, then it should be applied equally to all RF emissions, Part 15 or not, with directional antennas or not.

C. REMOVAL OF EIRP LIMITS AT 2450 MHz AND 5800 MHz

WMC's position, as stated in our petition, is to support the permanent removal of EIRP limits in both the 2450 MHz and 5800 MHz bands. Our years of experience operating without EIRP limits under our current FCC waiver confirm our engineering calculations (Attachment 1) which clearly show that when there may be potential interference from long distance systems with directional antennas into non-directional systems, the long distance system will not operate due to much more severe interference from the non-directional system. Additionally, under the existing Part 15 rules, if there should be any interference then it is the current responsibility of the

offending party to rectify the situation. Therefore, we encourage the FCC to support the current technical standards which are working well and strongly recommend that EIRP limits are not imposed in both the 2450 MHz and 5800 MHz bands

Background radiation from non-communications equipment operating in the ISM bands, under Part 18 of the rules, is also a concern. Part 18.305 states "ISM equipment operating on a frequency specified in 18.301 (including the 915 MHz, 2450 MHz and 5800 MHz bands) is permitted unlimited radiated energy in the band specified for that frequency." Detailed studies of background radiation, including the 915 MHz and 2450 MHz frequency bands, have been made by the National Telecommunications & Information Administration[1] These studies show that considerable background radiation is present in the two above mentioned ISM bands. Microwave ovens are the main source of the background radiation Limiting the EIRP to 6 dBW will cause the received signal levels from Part 15 communication transmitters to fall well below the background radiation from non-communications equipment, making these applications unusable

D. HIGH GAIN ANTENNAS LIMITED TO COMMERCIAL OR INDUSTRIAL OPERATORS OF FIXED POINT-TO-POINT SYSTEMS ONLY

WMC welcomes the FCC's statement in paragraph 13 on page 6 of the NPRM that provides a clear endorsement of the use of Part 15 equipment by commercial operators (such as all common carriers) Also, we have no objection to the exclusion of sales of systems using high gain antennas to the general public because all our customers are commercial and industrial operators who will professionally install their equipment However, we feel that restricting users to commercial and industrial operators may unreasonably prevent other users (such as local

[1] NTIA Special Publication 94-27 and NTIA Report 91-279

government and educational users) from operating good professionally installed systems. In general, we do not support any new restrictions on the use of unlicensed spread spectrum systems to qualified purchasers. Therefore, we propose that any restriction should be limited to professionally installed antennas rather than to call out these two categories that are not, in any case, explicitly defined. Additionally, WMC proposes that the term 'high gain antennas' not be used because it promotes the misconception that antennas are not passive devices. Antennas can be described as 'directional' or 'narrow beam', but 'high gain' incorrectly implies that antennas have the same effect as an RF power amplifier (see further discussion below.)

E. CONCERNS OVER THE USE OF DIRECTIONAL ANTENNAS ARE UNFOUNDED

The NPRM states in paragraph 9 on page 5: "However, because the use of high power radio links without prior frequency coordination *could* result in significant interference problems to other operators using these frequency bands, we *believe* it is necessary to restrict their use." WMC does not know of any theoretical studies or operational data to support the *belief* that limiting the EIRP to 6 dBW is in the public interest. WMC does not know of any case of reported unacceptable interference in the 2450 MHz or 5800 MHz bands due to spread spectrum systems being operated at powers in excess of 6 dBW.

Further, directional systems are not high power radio links because they are subject to the same transmitter power limit (1 Watt) as non-directional systems.

The NPRM continues in paragraph 10 on page 5: "These bands, especially the 915 MHz and the 2450 MHz bands, are now becoming more crowded, particularly with mobile units, increasing the potential that spread spectrum systems using high gain antennas will cause harmful

interference." WMC contends that just the opposite is the case. The use of directional, narrow beamwidth antennas increases the ability to reuse a given frequency, in a given area, relative to the use of omnidirectional or wide beamwidth antennas. As mobile units typically use omni-directional antennas, they are the worst polluters. Since the unlicensed Part 15 bands are intended to be multi-user, operators should be encouraged to install directional antennas for maximum efficiency.

F. SOME METHOD TO REDUCE POTENTIAL FOR EXCESSIVE RF EXPOSURE LEVELS

The NPRM voices an unfounded concern over excessive exposure levels in paragraph 14 on page 7; "While we proposed to make the operator responsible for ensuring that the system is only used for fixed, point-to-point applications, the means to prevent excessive exposure levels can be incorporated into the equipment design. Comments are requested concerning possible biological hazards from high effective radiated power levels that could be emitted from these systems, any additional methods that can be employed to prevent unnecessary exposure of the public, and whether we should prescribe the use of specific means for preventing such exposure."

WMC believes that this concern shows a lack of technical understanding of the nature of directional antennas; there is no likelihood of higher exposure levels when using directional antennas compared to omnidirectional antennas. It is like comparing lasers (active devices) to antennas (passive devices).

When stated in footnote 9 of the NPRM that "Under WMC's request, it is conceivable that directional antennas gains of 30 dB, or greater, could be employed with these transmitters producing effective radiated powers in excess of 1000 Watts and transmission ranges in excess of 20 km." there is an incorrect implication that 1000 Watts of power will be transmitted. However,

the total actual radiated power is only 1 Watt maximum in both the omnidirectional and the directional cases. In fact, the directional antenna spreads out the power into an area determined by the size of the antenna. Higher gain antennas have larger size dishes, which disperse the power in front of the antenna into a large area that is at least as great as the dish sectional area. This area is much larger in diameter than a laser beam (several square meters vs. several square millimeters - a difference of six orders of magnitude!). Dispersing the energy over this area actually results in a lower concentration of power (as measured in mW/cm^2 for example) and thus a lower total exposure.

As an example, a cellular/PCS handheld telephone will transmit RF power at levels up to 1 Watt, with an omnidirectional antenna next to the user's head. This exposure level is extremely high because up to 50% of all the power can be absorbed by body tissue with no path loss. In fact, the exposure level is likely to be high for long periods, many times a week.

A similar situation exists for indoor spread spectrum systems using omnidirectional antennas, such as wireless LANs. However, all the existing evidence shows that this exposure does not present a significant health risk. In contrast, directional antennas are too big to be placed next to anyone's head. Even if someone was standing in front a directional antenna, most of the transmit power would not be absorbed by their body because it would be spread out over the dish surface. Calculations show that orders of magnitude less power will be absorbed even if standing right in front of a directional antenna (which you probably wouldn't do for long periods, several times a week), compared to a hand-held wireless device with an omnidirectional antenna (see Attachment 2).

WMC would be strongly averse to any rules that would require decreasing transmit output power due to a proximity sensor because this is completely unnecessary. Further, it is not in the public interest because it would seriously affect the ability of the user to obtain a reliable system.

A final point on this topic, because directional antennas at 2450 MHz and 5800 MHz require a line-of-sight to the far location, they are generally professionally installed in high locations free from obstructions, such as on top of the roofs of buildings or on towers where the general public has no access. So, in addition to the previous argument, we further see no reason why there should be any concern over exposure to levels from inaccessible directional antennas. There certainly should be no more concern for unlicensed systems than for current licensed microwave radio systems, which have been widely used with directional antennas by commercial and industrial operators for over 50 years with EIRP powers up to +55 dBW at similar frequencies.

G. FIXED POINT-TO-POINT OPERATION

As one of the most important applications for Part 15 spread spectrum radios is disaster recovery, it is essential that temporary installations are permitted under these rules and that operation is not restricted to the traditional fixed requirements. Similarly, while multiple co-located systems transmitting the same information would not be desirable, there is a requirement for operators to reach remote locations using links at 2450 MHz and 5800 MHz while not having line-of-sight paths. In order to accomplish these systems, repeaters with directional antennas, pointing in two directions, are both required and desirable

H. POSSIBLE ACTIONS TO LIMIT OPERATION NEAR CANADIAN AND MEXICAN BORDERS

Another concern expressed in the NPRM is interference across borders into Canada or Mexico; in paragraph 15, "Commenting parties may also wish to address actions that could be taken to limit operation near the Canadian and Mexican borders to avoid unauthorized crossborder operations and interference to licensed systems in Canada and Mexico." We believe that the use of directional antennas will inherently tend to minimize the transmission of signals into Mexico and Canada because signals will be directed only towards the receiving location which will be in the USA. Also, there would currently appear to be existing in-country remedies against unauthorized transborder operations. We support the FCC's proposal not to incorporate any additional regulatory burden into the Rules on this issue

I. TECHNICAL STANDARDS TO RESTRICT TRANSMITTER OUTPUT POWER BY 1 dB FOR EVERY 3 dB THAT THE GAIN OF A DIRECTIONAL ANTENNA EXCEEDS 6 dBi

In paragraph 16, page 7 of the NPRM: "We propose that the output power of the transmitter would need to be decreased by 1 dB for every 3 dB that the antenna gain exceeds 6 dBi in order to maintain an "equivalent" area of interference, i.e., the geographic area over which interference could result with a directional antenna as compared to the area obtained with an omnidirectional antenna. While this would result in a slight reduction in the effective radiated power level of the system, the higher gain employed by the antenna would still be available to amplify the received signal." Obviously, we think that this specification is unnecessary

We support the goal stated in the NPRM (paragraph 11) that the limit on directional antennas should be eliminated and we propose that it should be eliminated at 2450 MHz as well as 5800 MHz. However, this proposal does not accomplish that goal and adds complications. Also, WMC does not agree with the stated reason which is the "equivalent area of interference" reference. Finally, the ability to obtain system gain on the receive side has always been present, whether the EIRP limit is 6 dBW or otherwise. This specification is not in the public interest because it would unnecessarily increase the cost and greatly (not slightly) reduce the range and restrict the use of point-to-point systems that are currently greatly valued by industrial and commercial operators. It clearly constitutes micro-managing the standards of what is, after all, unlicensed frequency bands.

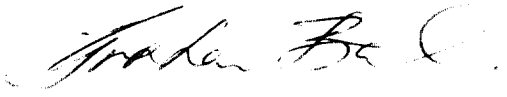
J. TECHNICAL STANDARDS TO LIMIT DIFFERENCES BETWEEN VERTICAL AND HORIZONTAL BEAMWIDTHS OF DIRECTIONAL ANTENNAS

Finally, in paragraph 17 of the NPRM: "Comments are also requested on whether the rules should specify limits on the horizontal and vertical beamwidths of antennas used with these point-to-point systems. We believe that any interference problems resulting from excessive vertical emissions could be resolved if the 3 dB beamwidths, in both the vertical and the horizontal planes, of the high gain directional antennas employed with these fixed, point-to-point systems differ by no more than a factor of two and are proposing such a limit." We do not see an operational problem with this specification because all of our users employ high quality antennas. However, as with the specifications discussed above, it does also constitute an unnecessary micromanaging of unlicensed spectrum.

CONCLUSION

WMC agrees with the Commission on all the proposed changes to the regulations contained in Appendix B of the NPRM with the significant exceptions described in these comments, above.

Respectfully submitted,



Graham Barnes
Director of Marketing
Western Multiplex Corporation

Interference Calculations

Between spread spectrum transmitters in point-to-point systems with directional antennas and point-to-multipoint systems with omnidirectional antennas in the 2450 MHz ISM band

Section 1 - Introduction

There is a perceived problem involving point-to-point (PTP) systems with directional antennas causing severe interference into point-to-multipoint (MPT) systems because their directional antennas have high gain.

The following calculations look at the potential interference which may result when an outdoor long distance PTP spread spectrum system with directional antennas is operated in the vicinity of an indoor MPT spread spectrum system with omnidirectional antennas. Assumptions are used to model actual systems based on typical hardware in use today. The PTP system performance is modeled on a Western Multiplex LYNX.cp2 T1 radio. The MPT system is modeled on a wireless LAN system.

Section 2 - Assumptions and Conditions

PTP system

The PTP system is assumed to be transmitting line-of-sight with a building containing the MPT system partially blocking (knife edge, worst case) the path at only 1,000 m from the PTP transmitting antenna.

1. PTP path length = 40 km
2. Directional antenna gain = 27 dBi (4' dish)
3. Transmitter output power = 1 watt (same as MPT system)
4. Frequency = 2450 MHz (same as MPT system)
5. C/I limit = 6 dB
6. Building loss = 10 dB (outside wall)

MPT system

The MPT system is assumed to be operating in the top floor of the building that is partially blocking the PTP line-of-sight path and is in the main beam of the PTP antenna.

1. MPT path length = 50 m
2. Omnidirectional antenna gain = 6 dBi
3. Transmitter output power = 1 watt (same as PTP system)
4. Frequency = 2450 MHz (same as PTP system)
5. C/I limit = 0 dB
6. Building loss = 10 dB (outside wall)

Section 3 - Calculations

1. PTP system interference into MPT system

Net path loss to the nearest MPT receiver
= Path loss (1,000 m) + Building loss - PTP antenna gain - MPT antenna gain
= (92.4 + 20 log 2.45 + 20 log 1) + 10 - 27 - 6 dB
= 77.18 dB

Net path loss to the within MPT system = Path loss (50 m) - 2 x MPT antenna gain
= (92.4 + 20 log 2.45 + 20 log 0.05) - 2 x 6 dB
= 62.16 dB

C/I (carrier-to-interference ratio) = difference between PTP and MPT path loss (above)
= 77.18 - 62.16 dB
= 15 dB

C/I margin = 15 - 0 dB
= 15 dB

Result: the MPT system has 15 dB interference margin!

2. MPT system interference into PTP system

Net path loss to the PTP receiver from nearest MPT transmitter
= Path loss (1,000 m) + Building loss - PTP antenna gain - MPT antenna gain
= (92.4 + 20 log 2.45 + 20 log 1) + 10 - 27 - 6 dB
= 77.18 dB

Net path loss to the within PTP system = Path loss (40 km) + knife edge loss (6 dB best case) - 2 x PTP antenna gain
= (92.4 + 20 log 2.45 + 20 log 40) + 6 - 2 x 27 dB
= 84.22 dB

C/I (carrier-to-interference ratio) = difference between PTP and MPT path loss (above)
= 77.18 - 84.22 dB
= -7 dB

C/I margin = -7 -6 dB
= -13 dB

Result: the PTP system is unusable!

Section 4 - Conclusions

There is a perceived problem involving point-to-point systems with directional antennas causing severe interference into point-to-multipoint systems because their directional antennas have high gain.

However, the calculations show that a point-to-multipoint system causes far greater interference into a point-to-point system, than a point-to-point system does into a point-to-multipoint system.

This conclusion is the opposite of the perceived problem

Health and Safety Comparisons

Between systems using omnidirectional (low gain) and directional (high gain) antennas

Section 1 - Introduction

There is a percieved health and safety hazard if the EIRP limits for Part 15 spread spectrum emissions are eliminated for directional antenna applications. The following information is presented to illustrate a comparison between a common point-to-point Part 15 spread spectrum radio and a cordless telephone.

Section 2 - Comparison

	Cordless Telephone	Point-to-Point
Frequency band:	2.4GHz ISM	2.4GHz ISM
Tx Output Power:	1 Watt	1 Watt
Antenna Gain:	0 dB	38 dB (15ft)
Proximity:	< 5 cm	> 2 meters
Radiation:	milliW/ sq cm	microW/ sq cm
Exposure:	Many times/day	Few times/year
Duration:	Tens of min/day	Few min/year
Severity of Exposure:	Insignificant??	None - even less